MIC7400/1 Programming Board User's Guide

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Object of Declaration: MIC7400/1 Programming Board User's Guide

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Signed for and on behalf of Microchip Technology Inc. at Chandler, Arizona, USA.

Rodger Richey
Director of Development Tools

Date

NOTES:

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Preface

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Documents are identified with a "DS" number. This number is located on the bottom of each page, in front of the page number. The numbering convention for the DS number is "DSXXXXXXXXA", where "XXXXXXXX" is the document number and "A" is the revision level of the document.

For the most up-to-date information on development tools, see the MPLAB® IDE online help. Select the Help menu, and then Topics, to open a list of available online help files.

INTRODUCTION

This chapter contains general information that will be useful to know before using the MIC7400/1 Programming Board. Items discussed in this chapter include:

DOCUMENT LAYOUT

This document describes how to use the MIC7400/1 Programming Board as a development tool to emulate and debug firmware on a target board. The manual layout is as follows:

- **Chapter 1. "Product Overview"** – Important information about the MIC7400/1 Programming Board.
- **Chapter 2. "Installation and Operation"** – Provides a detailed overview of the MIC7400/1 Programming Board main hardware components and connectors; includes an in-depth account of the MIC7400/1 Programming Board modes of operation, and the board's typical usage scenarios.
- **Appendix A. "Schematic and Layouts"** – Shows the schematic and layout diagrams for the MIC7400/1 Programming Board.
- **Appendix B. "Bill of Materials (BOM)"** – Lists the parts used to build the MIC7400/1 Programming Board.

CONVENTIONS USED IN THIS GUIDE

This manual uses the following documentation conventions:

DOCUMENTATION CONVENTIONS

Description	Represents	Examples
Arial font:		
Italic characters	Referenced books	*MPLAB® IDE User's Guide*
	Emphasized text	...is the *only* compiler...
Initial caps	A window	the Output window
	A dialog	the Settings dialog
	A menu selection	select Enable Programmer
Quotes	A field name in a window or dialog	"Save project before build"
Underlined, italic text with right angle bracket	A menu path	*File>Save*
Bold characters	A dialog button	Click **OK**
	A tab	Click the **Power** tab
N'Rnnnn	A number in verilog format, where N is the total number of digits, R is the radix and n is a digit.	4'b0010, 2'hF1
Text in angle brackets < >	A key on the keyboard	Press <Enter>, <F1>
Courier New font:		
Plain Courier New	Sample source code	`#define START`
	Filenames	`autoexec.bat`
	File paths	`c:\mcc18\h`
	Keywords	`_asm, _endasm, static`
	Command-line options	`-Opa+, -Opa-`
	Bit values	`0, 1`
	Constants	`0xFF, 'A'`
Italic Courier New	A variable argument	*`file`*`.o`, where *`file`* can be any valid filename
Square brackets [ ]	Optional arguments	`mcc18 [options]` *`file`* `[options]`
Curly brackets and pipe character: { | }	Choice of mutually exclusive arguments; an OR selection	`errorlevel {0|1}`
Ellipses...	Replaces repeated text	`var_name [, var_name...]`
	Represents code supplied by user	`void main (void) { ... }`

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RECOMMENDED READING

This user's guide describes how to use the MIC7400/1 Programming Board. Other useful documents are listed below. The following Microchip documents are available and recommended as a supplemental reference resource:

- **MIC7400 Data Sheet, Revision 1.0**
- **MIC7401 Data Sheet, Revision 1.0**
- **MIC7400 Evaluation Board User's Guide, Revision 1.0**
- **MIC7401 Evaluation Board User's Guide, Revision 1.0**

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- Technical Support

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Technical support is available through the web site at:
http://www.microchip.com/support.

DOCUMENT REVISION HISTORY

Revision A (September 2017)

- Initial Release of this Document.

Chapter 1. Product Overview

1.1 INTRODUCTION

This chapter provides an overview of the MIC7400/1 Programming Board and covers the following topics:

- MIC7400/1 Programming Board Short Overview
- MIC7400/1 Programming Board Key Features
- What Is the MIC7400/1 Programming Board?
- What Does the MIC7400/1 Programming Board kit Include?

1.2 MIC7400/1 PROGRAMMING BOARD SHORT OVERVIEW

The MIC7400/1 Programming Board is designed to demonstrate the MIC7400/1 Power Management IC (PMIC) when programmed by a microcontroller, using an easy-to-understand interface. The board offers increased functionality by the addition of an on-board EEPROM and allows the user to copy, store and also reprogram all the registers in the MIC7400/1 devices.

1.3 MIC7400/1 PROGRAMMING BOARD KEY FEATURES

The MIC7400/1 Programming Board has the following features:

- Power options: stand-alone battery powered by one-coin cell (CR2032), USB or external 5V source
- On-board EEPROM(2K) for MIC7400/1's parameters backup and reprogramming
- 8 modes of operation for extensive functionality
- Power-Good live LED indicators for all 6 outputs
- LCD screen with intuitive text for an easy-to-use experience
- MIC7400/1 device cloning when interfaced with the MIC7400/1 GUI, using the MIC2221 integrated on the MIC7400 and MIC7401 Evaluation Boards.

1.4 WHAT IS THE MIC7400/1 PROGRAMMING BOARD?

The MIC7400/1 Programming Board is used to demonstrate the Microchip Technology, Inc., MIC7400/1 PMIC on-the-fly programmability by a microcontroller. The MIC7400/1 Programming Board is used to:

- copy and store the content of the MIC7400/1's internal EEPROM into the on-board EEPROM
- program a new MIC7400/1 with the stored configuration
- modify the output voltages and current limits for both Normal and Stand-by modes
- program the regulators outputs start-up sequence and the delay between them.

The LCD interface is user friendly and intuitive, with all the information needed being provided on the screen. A rotary switch is used to change modes of operation.

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1.5 WHAT DOES THE MIC7400/1 PROGRAMMING BOARD KIT INCLUDE?

The MIC7400/1 Programming Board kit includes the following items:

- MIC7400/1 Programming Board (ADM00760)
- Important Information Sheet

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Chapter 2. Installation and Operation

2.1 INTRODUCTION

This chapter details the components, setup and utilization of the MIC7400/1 Programming Board.

2.2 MIC7400/1 PROGRAMMING BOARD – OVERVIEW

The main components of the MIC7400/1 Programming Board are:

- Battery ON/OFF switch - used to turn on the MIC7400/1 Programming Board while being powered by the on-board coin-cell battery
- PIC16F1509 - the main controller of the MIC7400/1 Programming Board that communicates with the MIC7400/1 and the LCD display, as well as interfacing with other on-board hardware peripherals, such as the LED indicators, switches and potentiometers
- LCD display - shows information relevant to the mode selected, depending on the action taken by means of the **Select** switch
- PG1 to PG 6 LEDs used to indicate if the MIC7400/1 output voltages are above 91% of the target value. This information is read from the MIC7400/1 Power-Good Register (00'h)
- **Select** switch - used to select the desired mode of operation
- **Voltage** and **Current** potentiometers used for selecting:
  - voltage and current, while in modes 1-6
  - channel and sequence (with SEL set to NORM), or sequence delay (with SEL set to STBY), while in mode 7
- **READ** button:
  - used to copy the MIC7400/1 internal EEPROM into the on-board EEPROM, while in mode 0
  - switching operating states, from Normal to Standby and vice-versa, while in modes 1-6
- **WRITE** button:
  - used to copy the content of the on-board EEPROM into the MIC7400/1 internal EEPROM, while in mode 0 (registers 02'h - 23'h)
  - in modes 1-6: used to write the selected voltage to the MIC7400/1 volatile memory and the on-board EEPROM
  - in mode 7: used to save the channel and start-up delay to the MIC7400/1 volatile memory and the internal EEPROM
- **SEL** switch:
  - used to select between Normal and Standby operation while writing the desired voltages and currents, in modes 1-6
  - used to select between changing the channel sequence and sequence delay, in mode 7
- 2 Kbit of EEPROM for easy copy, back-up and restore of the MIC7400/1 internal registers
- an on-board battery (CR2032) for stand-alone usage. The MCP1624 Boost

Converter is used to create a regulated 5V supply for MIC7400/1 Programming Board. It boosts the coin-cell voltage (3V nominal) to the 5V needed by the LCD, EEPROM and the microcontroller. This voltage is also available on the J2 (if a jumper is placed on J7) connector (see Figure 2-2).

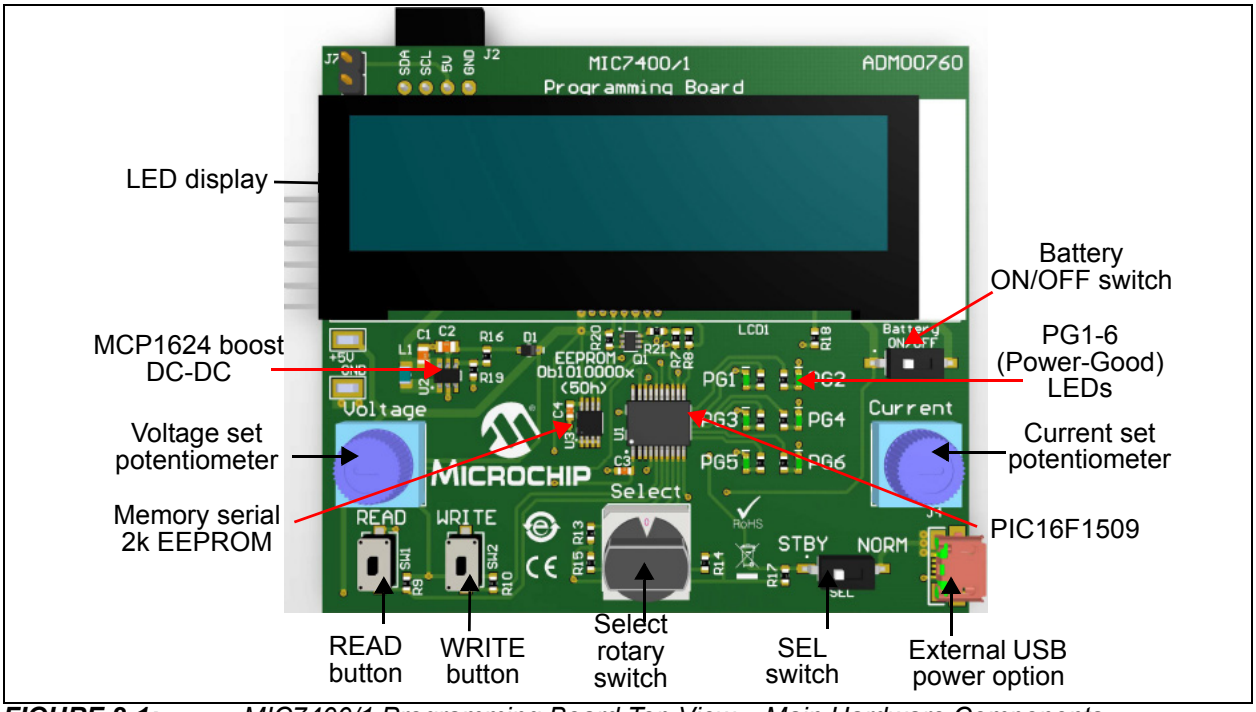

FIGURE 2-1: *MIC7400/1 Programming Board Top View – Main Hardware Components.*

There are four options of powering up the MIC7400/1 Programming Board:

- the on-board coin cell with the MCP1624 boost converter
- the USB power supply via a micro USB connector
- external power supply (requires 5V stable power supply)
- J2 header (by connecting a jumper to J7)

2.3 MIC7400/1 PROGRAMMING BOARD CONNECTORS

The MIC7400/1 Programming Board comes equipped with a standard 2.54 mm male connector for easy interfacing with the MIC7400/1 Evaluation Boards (ADM00811 and ADM00812). In order to enable communication with the MIC74001 GUI, the Programming Board must be connected to the MIC7400/1 Evaluation Board (using J2) and the Evaluation Board must be connected to a PC via USB.

To be recognized by the MIC7400/1 GUI, the on-board EEPROM must first be initialized (by reading any MIC7400/1 device).

NOTICE

In order to prevent conflict on the I2C bus, the Select switch must be moved to position 0 before connecting the MIC700/1 Evaluation Boards.

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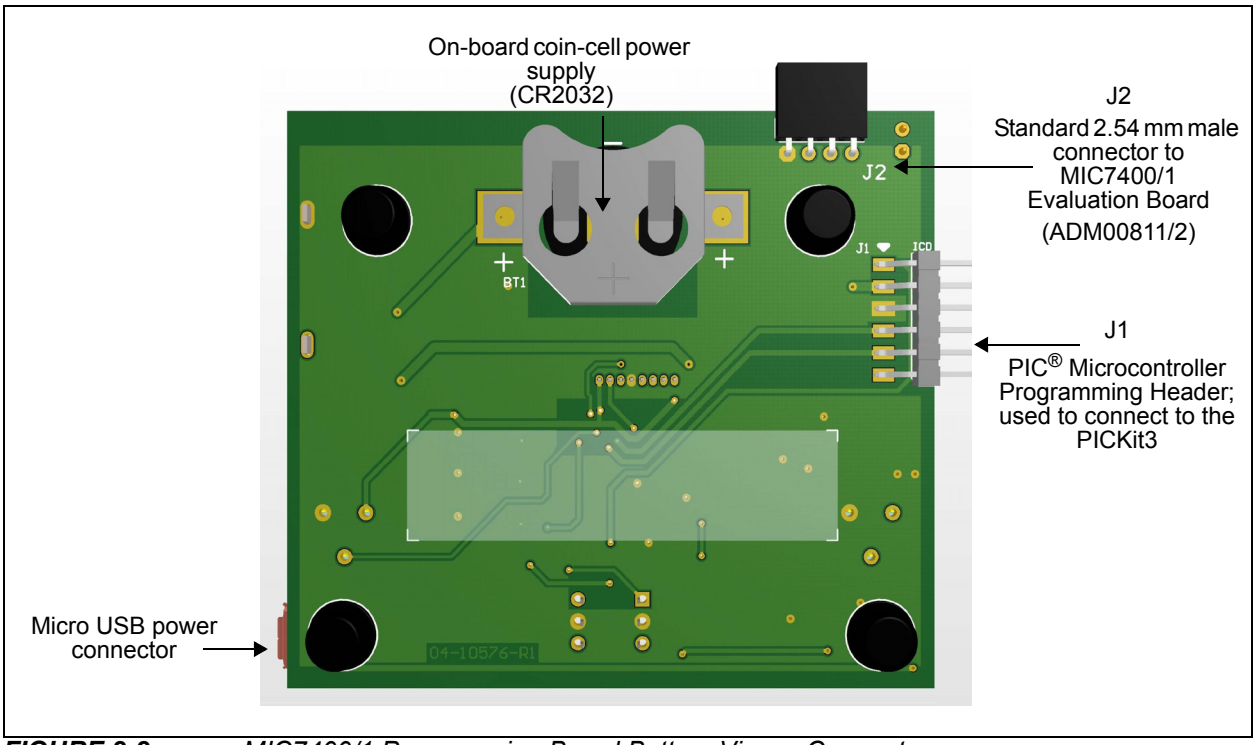

FIGURE 2-2: *MIC7400/1 Programming Board Bottom View – Connectors.*

2.4 USING THE MIC7400/1 PROGRAMMING BOARD

2.4.1 Powering and interfacing with the MIC7400/1 Programming Board

The MIC7400/1 Programming Board can be connected to any I^2C interface that has a MIC7400/1 connected. Great care must be taken when connecting to a complex I^2C system so that the MIC7400/1 Programming Board is the only MASTER active, otherwise false readings and writings may occur due to a conflict on the I^2C bus.

After power is applied to the MIC7400/1 Programming Board and to the attached device, the MIC7400/1 Programming Board can be turned on by switching ON the **Battery ON/OFF** switch (while being powered by the coin cell) or by switching on the external power supply.

2.4.2 Modes of Operation

The MIC7400/1 Programming Board software is structured around the **Select** rotary switch whose position determines the operating mode of the MIC7400/1 Programming Board and the functionality of the buttons and switches.

There are eight possible modes of operation. They are determined by the position of the **Select** rotary switch, as described in **Sections 2.4.2.1** through 2.4.2.4.

2.4.2.1 POSITION 0

In this position, the I^2C bus is active only for a few milliseconds while the welcome screen (“MICROCHIP MIC7400/1”) is displayed; after a few milliseconds, the activity on the I^2C bus stops.

Note: The integrated MCP2221 on the MIC7400/1 Evaluation Board can only be used while the MIC7400/1 Programming Board is in this mode, so there is no conflict between the microcontroller and the MCP2221. While using the MCP2221 (using the GUI to program the on-board EEPROM), pressing the **READ** or **WRITE** buttons is not advised.

In order to read the on-board EEPROM, the device address in the MIC7400/1 GUI must be changed to 0b1010000x (50h).

When not using the MIC2221 integrated on the MIC7400/1 Evaluation Board, the **READ** button can be used to read the content of the MIC7400/1 internal EEPROM and copy it to the on-board EEPROM. The PG 1-6 LEDs will light up in sequence to signal the start of the reading process and a "Reading..." message will be displayed on the LCD screen. If the action is successful, a message ("DONE") will briefly be displayed on the screen and the I^2C activity will stop.

When not using the MIC2221 integrated on the MIC7400/1 Evaluation Board, the **WRITE** button can be used to write the content of the on-board EEPROM to the MIC7400/1 internal EEPROM. The PG 1-6 LEDs will light up in sequence to signal the start of the writing process and a "Writing..." message will appear on the LCD screen. If the action is successful, the message "DONE" will briefly be displayed on the screen and the I^2C activity will stop.

If a read/write action cannot be started, due to an error on the I^2C bus or to the MIC7400/1 not responding, an "ERROR" message will appear on the screen and all PG1-6 LEDs will flash five times, after which the I^2C bus activity stops.

If a read/write action is started but cannot be completed, an "Action not comp." message will be displayed on the screen and all PG 1 – 6 LEDs will flash five times, after which the I^2C bus activity stops.

2.4.2.2 POSITIONS 1-6

In this mode, the **Voltage** and **Current** potentiometers can be used to set the voltage and the current limit of the selected regulator. Mode selection is done by means of the **SEL** switch, which enables writing to either the Standby (**STBY**) or Normal (**NORM**) mode of operation. Using the **Read** button, the current mode of operation for the attached MIC7400/1 can be changed.

After the desired voltage and current limit have been selected, press the **WRITE** button to write the new values to the MIC7400/1 temporary register and to the on-board EEPROM. These values will not be saved directly into the internal EEPROM of the MIC7400/1 and can be canceled by performing a power-down/power-up sequence. To save the newly-input values into the MIC7400/1 internal EEPROM, the **Select** switch must be changed to position 0 and the **WRITE** button must be pressed.

2.4.2.3 POSITION 7

This mode is used to assign each selected converter to the selected sequence and the delay between sequences.

When the **SEL** switch is set to NORM:

- the channel (buck or boost) can be selected with the **Voltage** potentiometer

- the sequence can be selected with the **Current** potentiometer

Once the desired channel and sequence have been selected, press the **WRITE** button to send the new configuration to the MIC7400/1 and to the on-board EEPROM. Flashing the PG LEDs 2 times confirms that the write action has been completed successfully.

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Switching **SEL** to STBY selects the sequence delay from 0 ms to 7 ms, by using the **Current** potentiometer. The configuration can be saved by pressing the **WRITE** button. Flashing the PG LEDs 2 times confirms that the write action has been completed successfully.

2.4.2.4 PG 1-6 (Power-Good) Status LEDs

The MIC7400/1 Programming Board is equipped with six green LEDs used to indicate the Power-Good status of the MIC7400/1 converters. These LEDs use the internal Power Good Register (00h) to determine the status of all six converters and work only when the board is in mode 1-7 (in mode 0 there is no activity on the I^2C bus).

2.5 TYPICAL USAGE EXAMPLES

2.5.1 Configure Device Settings and Upload Them to the MIC7400/1 EEPROM

Configuring the device settings by means of the **Voltage** and **Current** potentiometers is the most basic functionality of the MIC7400/1 Programming Board. Next are the steps necessary for configuring:

- connect the MIC7400/1 Programming Board to the desired MIC7400/1 via J2 connector (refer to Figure 2-2)
- power the MIC7400/1 Programming Board and the desired MIC7400/1
- bring the **Select** switch to position 0
- press the **READ** button to copy the MIC7400/1 registers to the MIC7400/1 Programming Board's EEPROM. The successful completion of the action is confirmed by a "DONE" message displayed on the screen (refer to **Section 2.4.2.1 "Position 0"**). This action is necessary in order to maintain the register values that are not modified by the board
- choose the desired channel by rotating the **Select** switch to a position that ranges from 1 to 6
- with the desired channel selected, choose the mode of operation (Stand-by or Normal) to which the configuration should be saved, by using the **SEL** switch
- use the **Voltage** and **Current** potentiometers to select the desired output voltage and current limit, respectively
- press the **WRITE** button to save the new configuration to the MIC7400/1 temporary memory and the on-board EEPROM.
- to copy the on-board EEPROM into the permanent MIC7400/1 internal EEPROM:
  - the **Select** switch must be changed to position 0
  - the **WRITE** button must be pressed

At any point, if the MIC7400/1 is powered down or reset, all settings in the temporary memory will be lost, but these will still be present in the on-board EEPROM, so that a write cycle to MIC7400/1 will restore and save them.

Note that regardless if the MIC7400/1 is connected to the MIC7400/1 Programming Board or not, the on-board EEPROM will still be written to.

2.5.2 Copy the Settings from the MIC7400/1 GUI to the MIC7400/1 Programming Board, Then Upload Them to Any MIC7400/1 EEPROM

If the MIC7400/1 configurations have already been done and saved using the MIC7400/1 GUI, the user can save all the registers to the MIC7400/1 Programming Board's EEPROM and then program other MIC7400/1 devices without the help of the MIC7400/1 GUI.

2.5.2.1 MIC7400/1 GUI SETTINGS TO THE MIC7400/1 PROGRAMMING BOARD EEPROM

To copy the MIC7400/1 GUI configurations to the MIC7400/1 Programming Board, this sequence must be used:

- if the MIC7400/1 Programming Board was previously used to read the registers of a MIC7400/1, these steps will be optional; otherwise, the board must first be initialized (by reading a MIC7400/1):
  - connect a MIC7400/1 to the MIC7400/1 Programming Board via J2 connector (refer to Figure 2-2).
  - power the desired MIC7400/1 and the MIC7400/1 Programming Board
  - bring the **Select** switch to position 0
  - press the **READ** button. The successful completion of the action is confirmed by a "DONE" message displayed on the screen. Refer to **Section 2.4.2.1 "Position 0"**
- connect any MIC7400/1 Evaluation Board by using the standard 2.54 mm female header situated on the board's top left corner (J2) and power the MIC7400/1 Programming Board
- rotate the **Select** switch to position 0
- connect the MIC7400/1 Evaluation Board to the GUI by using a USB cable
- start the MIC7400/1 GUI
- select the desired configuration
- in the MIC7400/1 GUI, click the **ScanAddr** button. In the **Addr** box, two devices should be detected: the MIC7400/1 PMIC (address 0x30, if powered) and the MIC7400/1 Programming Board on-board EEPROM (address: 0x50). Select the 0x50 address and press **Connect** button.
- go to the **OPERATION** section and click the **WriteAll** button. For additional information, refer to the MIC7400/MIC7401 Evaluation Board User's Guide

2.5.2.2 MIC7400/1 PROGRAMMING BOARD SETTINGS TO ANY MIC7400/1 DEVICE

To upload the MIC7400/1 Programming Board configurations to any MIC7400/1 device, the following steps must be taken:

- connect a MIC7400/1 device to the MIC7400/1 Programming Board via J2 connector (refer to Figure 2-2)
- power the MIC7400/1 and the MIC7400/1 Programming Board
- bring the **Select** switch to position 0
- press the **WRITE** button; the successful completion of the action is confirmed by a "DONE" message. Refer to **Section 2.4.2.1 "Position 0"** for more information

2.5.3 Copy the Configuration across Multiple MIC7400/1 Devices; Export the Configuration to the MIC7400/1 GUI

The MIC7400/1 Programming Board can be used to copy the configuration of a MIC7400/1 device to another MIC7400/1 device, as well as, export the register values written in the board's EEPROM to the MIC7400/1 GUI.

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2.5.3.1 MIC7400/1 DEVICE TO MIC7400/1 DEVICE

To copy the configuration of a MIC7400/1 to another MIC7400/1, this sequence must be applied:

- connect the MIC7400/1 with the desired settings to the MIC7400/1 Programming Board via J2 connector
- power both the desired MIC7400/1 and the MIC7400/1 Programming Board
- rotate the **Select** switch to position 0
- press the **READ** button; the successful completion of the action is confirmed by a a “DONE” message. See **Section 2.4.2.1 “Position 0”**
- disconnect the MIC7400/1 Programming Board and reconnect it to the MIC7400/1 that the configuration needs to be transferred to
- power both the successive MIC7400/1 and the MIC7400/1 Programming Board
- make sure the board **Select** switch is in position 0
- press the **WRITE** button; a “DONE” message confirms that the action was successfully completed. See **Section 2.4.2.1 “Position 0”**

2.5.3.2 MIC7400/1 PROGRAMMING BOARD EEPROM TO MIC7400/1 GUI

To export the settings from the MIC7400/1 Programming Board to the MIC7400/1 GUI, the following sequence must be applied:

- connect any MIC7400/1 Evaluation Board to the MIC7400/1 Programming Board using the standard 2.54 mm female header situated on the boards top left corner (J2)
- bring the **Select** switch to position 0
- connect the MIC7400/1 Evaluation Board to the GUI using a USB cable
- power the MIC7400/1 Programming Board and start the MIC7400/1 GUI
- click the **ScanAddr** button. In the **Addr** box, two devices should be detected: the MIC7400/1 PMIC (address 0x30, if powered) and the MIC7400/1 Programming Board on-board EEPROM (address: 0x50). Select the 0x50 address and press **Connect** button.
- go to the **OPERATION** section tab and click the **ReadAll** button to read the configurations

2.5.4 Setting the Start-Up Sequence and Saving It to the MIC7400/1 EEPROM

This feature of the MIC7400/1 Programming Board allows the MIC7400/1 regulators to start in a predefined sequence and with a preset delay between them, necessary for the new generation of microprocessors and FPGAs.

These are the steps necessary for configuring the start-up sequence:

- connect the MIC7400/1 Programming Board to a MIC7400/1
- power both the MIC7400/1 Programming Board and the device connected to it
- bring the **Select** switch to position 7
- set the **SEL** switch to NORM
- use the **Voltage** potentiometer to select the desired channel (channels 1-5 for buck converters, and channel 6 for boost converter) and the **Current** potentiometer for selecting the desired place in the start-up sequence
- press the **WRITE** button to transfer the new data to the MIC7400/1 volatile memory and to the on-board EEPROM
- after the desired sequence has been set, move the **SEL** switch to STBY
- set the sequence delay by using the **Current** potentiometer. The sequence delay can be set between 0 and 7 ms. The display will show the newly set delay together with the previous delay set in the MIC7400/1

- press the **WRITE** button to memorize the new delay
- to make the new configuration permanent, rotate the **Select** switch to position 0 and press the **WRITE** button

Note: Note that pressing the **WRITE** button will permanently save the on-board EEPROM into the MIC7400/1 internal EEPROM.

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Appendix A. Schematic and Layouts

A.1 INTRODUCTION

This appendix contains the following schematics and layouts for the MIC7400/1 Programming Board (ADM00760):

- Board – Schematic
- Board – Top Silk
- Board – Top Copper and Silk
- Board – Top Copper
- Board – Bottom Copper
- Board – Bottom Copper and Silk
- Board – Bottom Silk

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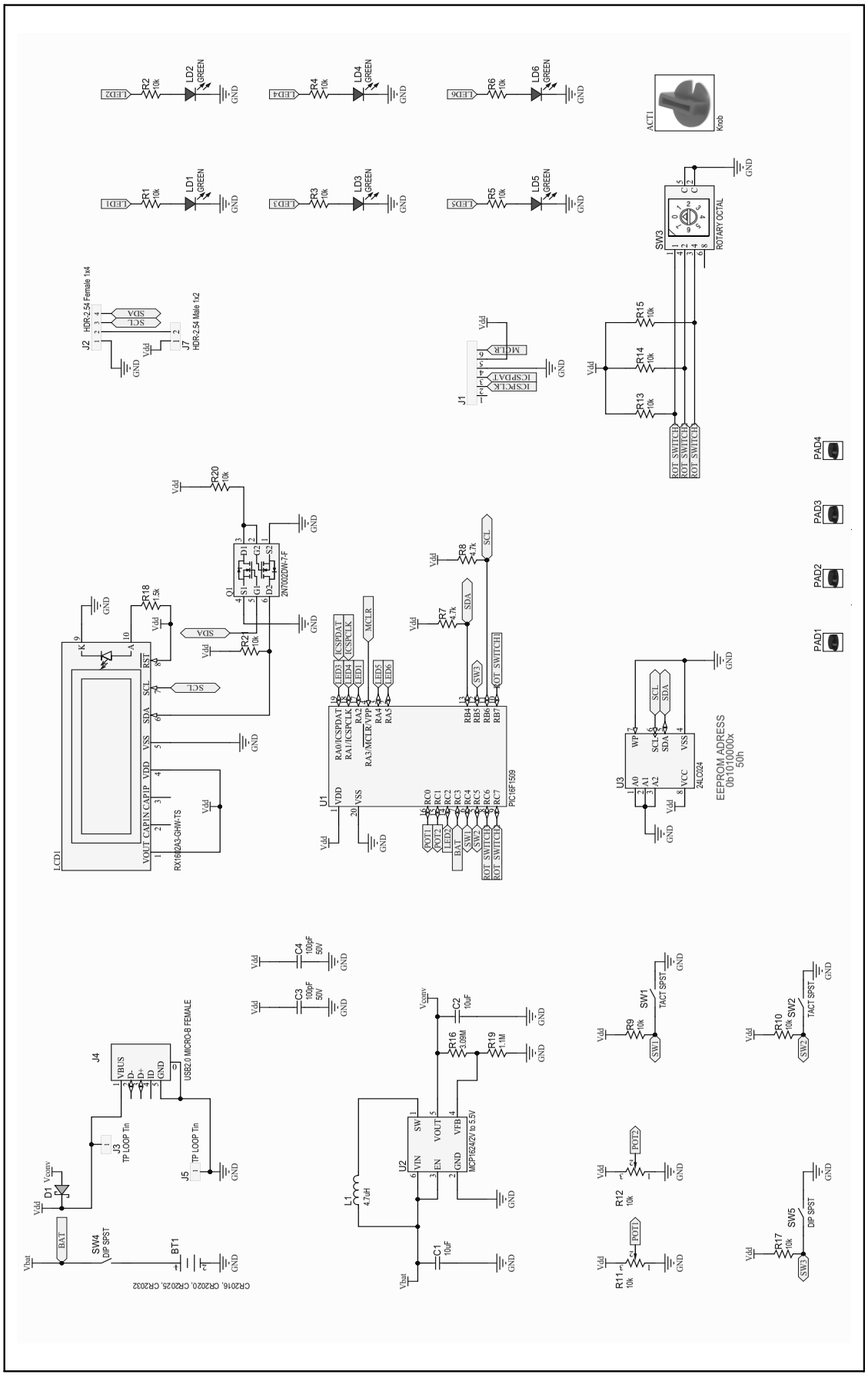
A.2 BOARD – SCHEMATIC



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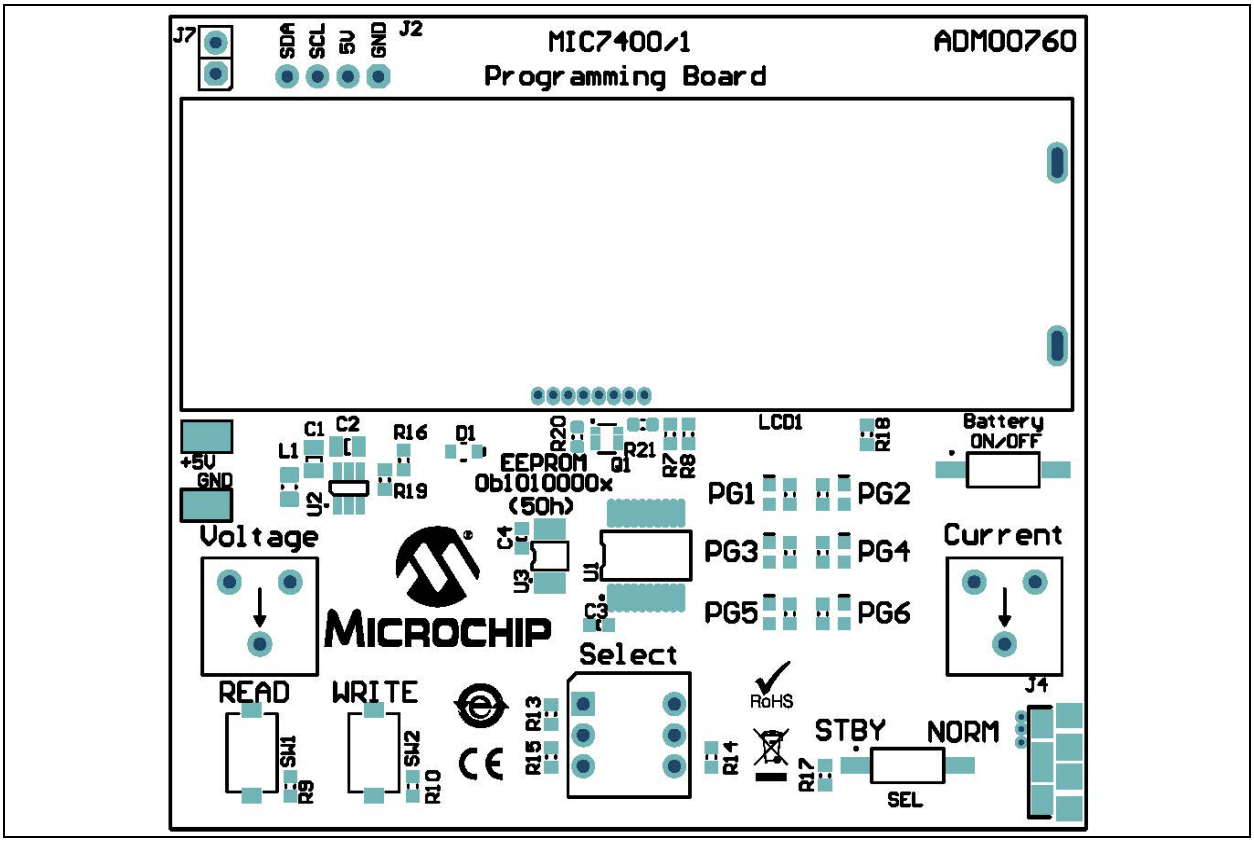
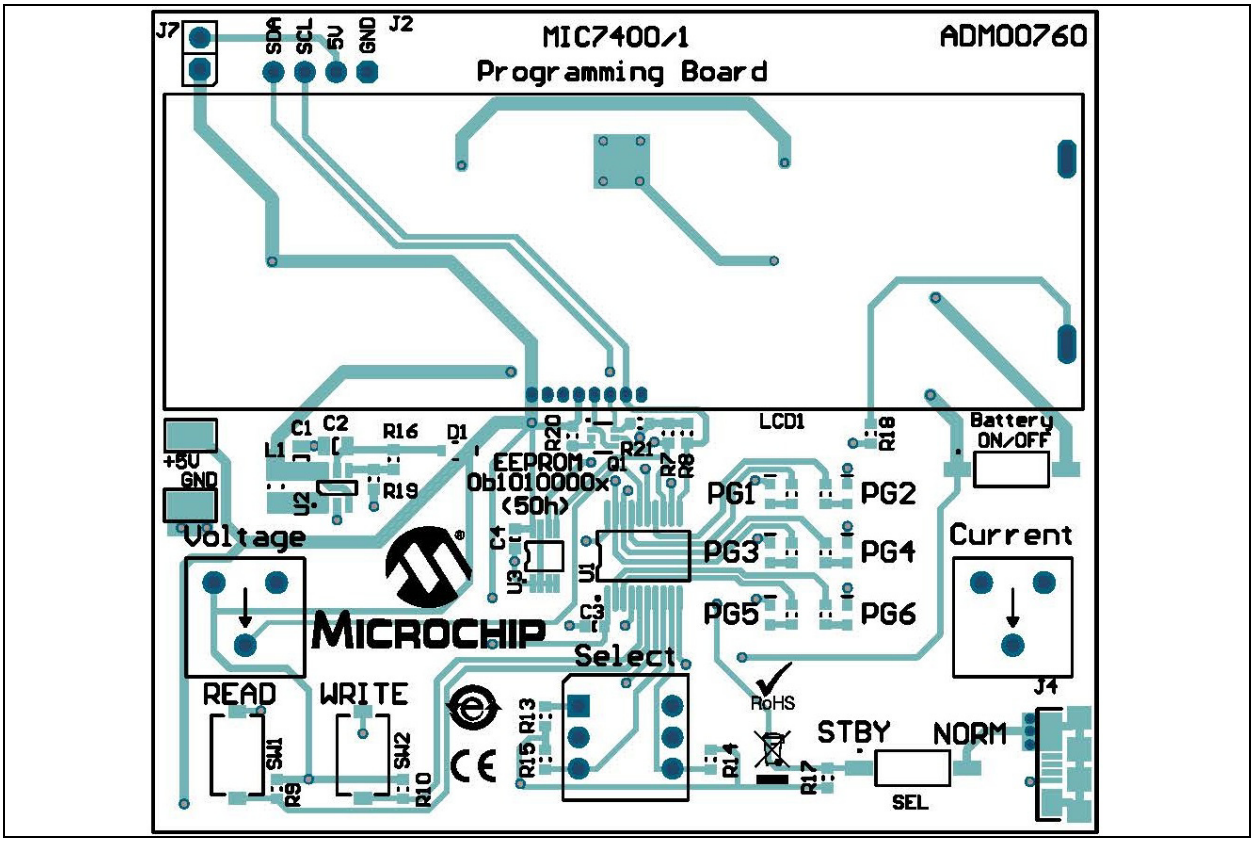
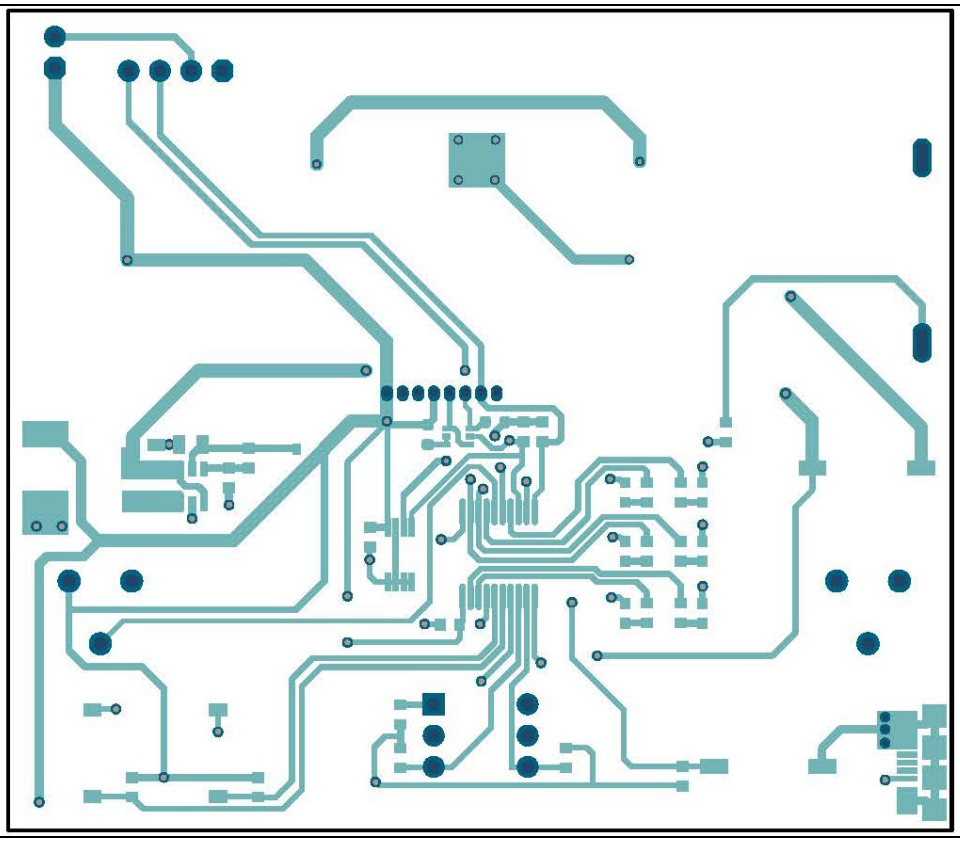
A.3 Board – Top Silk



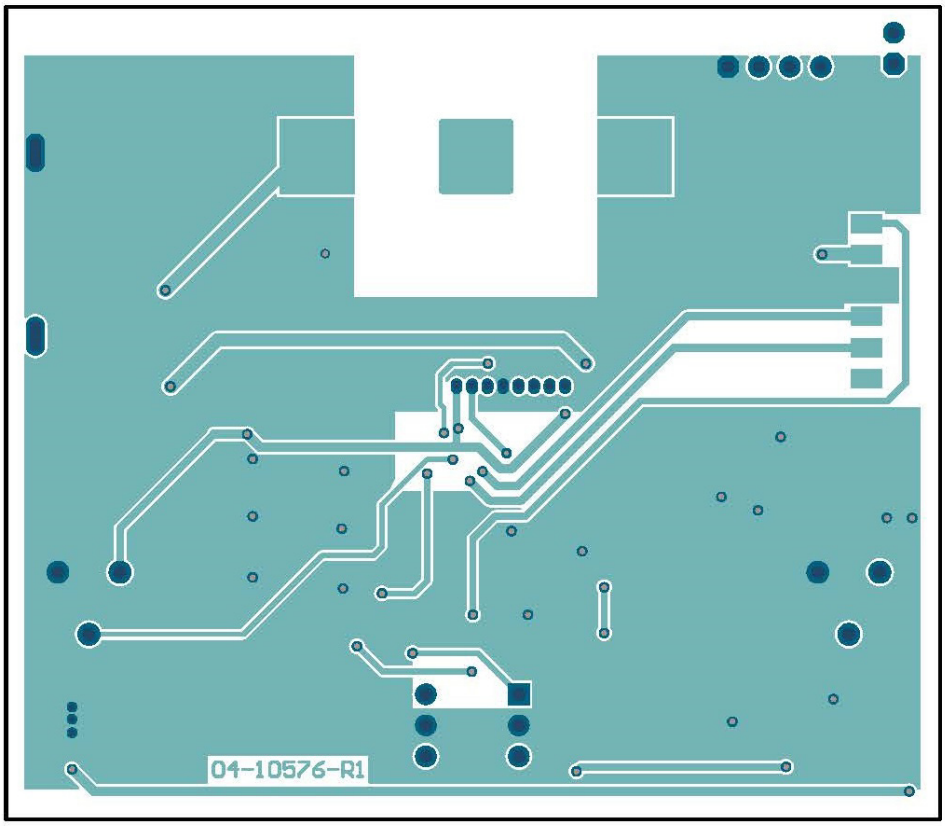
A.4 Board – Top Copper and Silk



A.5 Board – Top Copper



A.6 Board – Bottom Copper



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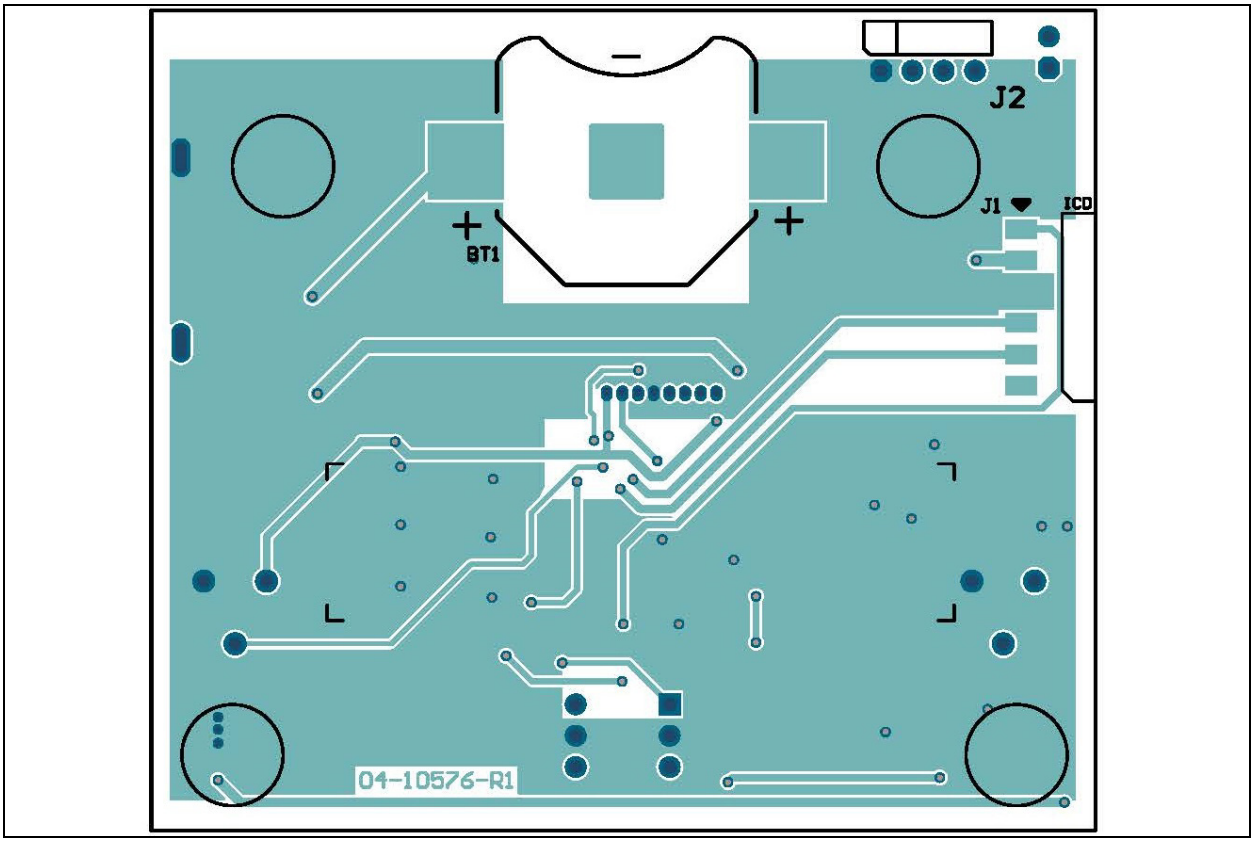
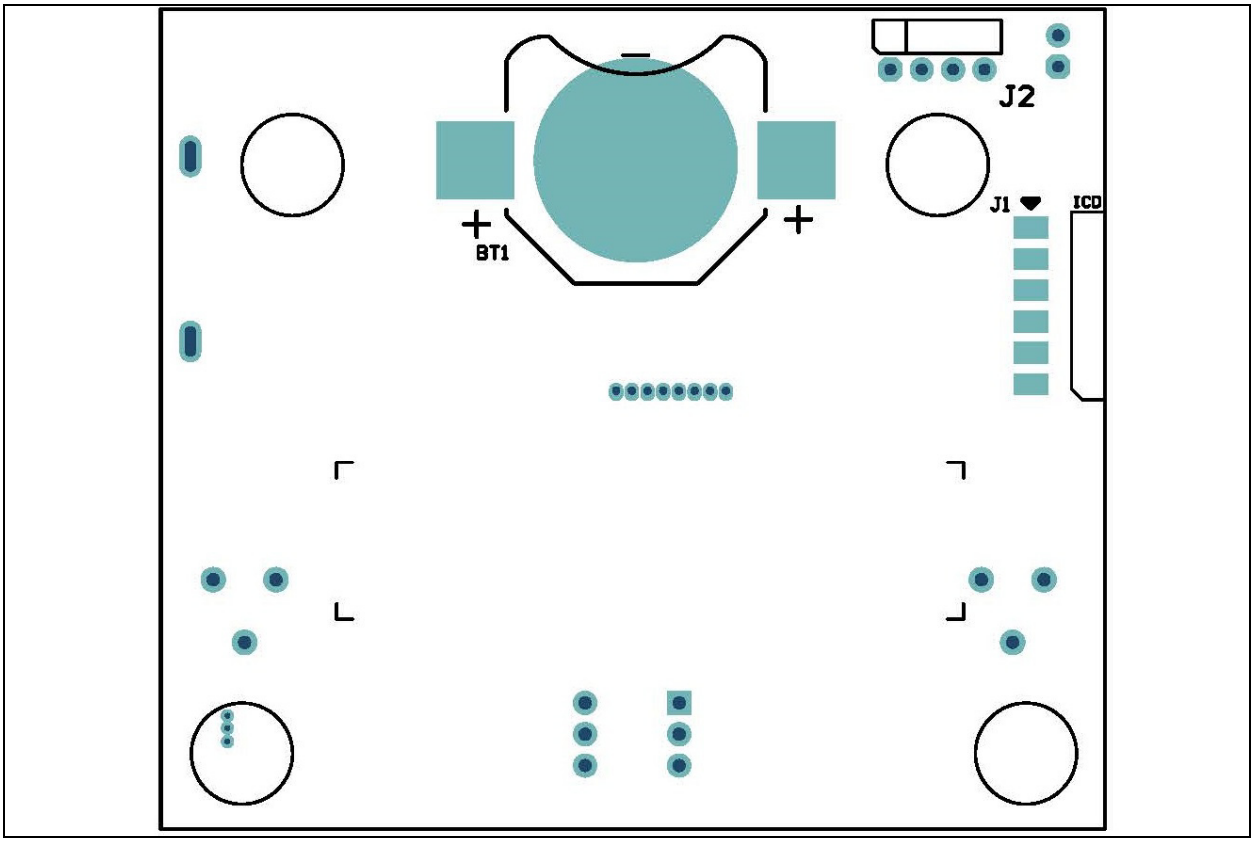
A.7 Board – Bottom Copper and Silk



A.8 Board – Bottom Silk



NOTES:

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Appendix B. Bill of Materials (BOM)

TABLE B-1:

Qty.	Reference	Description	Manufacturer	Part Number
1	ACT1	MECH HW KNOB WE-714287050 BLUE	Wurth Elektronik	714287050
1	BT1	BATT HOLDER Retainer SMD CR2016, CR2020, CR2025, CR2032	Keystone Electronics Corp.	3002TR
2	C1, C2	CAP CER 10uF 25V 10% X5R SMD 0805	TDK Corporation	C2012X5R1C106M/0.85
2	C3, C4	CAP CER 100pF 50V 1% C0G SMD 0603	TDK Corporation	C1608C0G1H101F
1	D1	DIO SCTKY B0520WS 430mV 500mA 20V SOD-323	Diodes Incorporated®	B0520WS-7-F
1	J1	CON HDR-2.54 Male 1x6 Gold 5.84MH SMD R/A	Sullins Connector Solutions	GBC06SBSN-M89
1	J2	CON HDR-2.54 Female 1x4 Gold TH R/A	Samtec, Inc.	SSW-104-02-G-S-RA
2	J3, J5	CON TP LOOP Tin SMD	Harwin Plc.	S1751-46R
1	J4	CON USB2.0 MICRO-B FEMALE SMD R/A	FCI	10118192-0001LF
1	J7	CON HDR-2.54 Male 1x2 Tin 6.10MH TH VERT	Molex®	0022284020
1	L1	INDUCTOR 4.7uH 230mOhm 20% 0805	Taiyo Yuden Co., Ltd.	587-2773-1-ND
1	LCD1	DISPLAY LCD RX1602A3-GHW-TS 16x2 Alpha 3V-5V TH	Midas, Inc	MCCOG21605C6W-SPTLYI
6	LD1, LD2, LD3, LD4, LD5, LD6	DIO LED GREEN 2V 30mA 35mcd Clear SMD 0603	Lite-On®, Inc.	LTST-C191KGKT
4	PAD1, PAD2, PAD3, PAD4	MECH HW RUBBER PAD CYLINDRICAL D7.9 H5.3 BLACK	3M	SJ61A11
1	Q1	TRANS FET DUAL N-CH 2N7002DW-7-F 60V 230mA 310mW SOT-363	Diodes Incorporated®	2N7002DW-7-F
1	PCB1	MIC7400/1 Programming Board - Printed Circuit Board	—	04-10576-R1
14	R1, R2, R3, R4, R5, R6, R9, R10, R13, R14, R15, R17, R20, R21	RES TKF 10k 5% 1/10W SMD 0603	Panasonic® - ESG	ERJ-3GEYJ103V
2	R7, R8	RES TF 4.7k 0.5% 1/10W SMD 0603	Yageo Corporation	RT0603DRD074K7L

Note 1: The components listed in this Bill of Materials are representative of the PCB assembly. The released BOM used in manufacturing uses all RoHS-compliant components.

TABLE B-1: (CONTINUED)

Qty.	Reference	Description	Manufacturer	Part Number
2	R11, R12	RES TRIMMER Cermet 10k 10% 500mW TH 3386F	Bourns®, Inc.	3386F-1-103TLF
1	R16	RES TKF 3.09M 1% 1/10W SMD 0603	Vishay/Dale	CRCW06033M09FKEA
1	R19	RES TKF 1.1M 1% 1/10W SMD 0603	Vishay/Dale	CRCW06031M10FKEA
2	SW1, SW2	SWITCH TACT SPST 24V 50mA KSR231GLFS SMD 6X3.5mm	TE Connectivity Alcoswitch	147873-2
1	SW3	SWITCH ROTARY Octal 24V 150mA 428527520908 TH	Wurth Electronik	428527520908
2	SW4, SW5	SWITCH DIP SPST 24V 25mA 418121270801 SMD	OMRON Corporation	A6S-1104-H
1	U1	MCHP MCU 8-BIT 20MHz 14kB 512B PIC16F1509-I/SS SSOP-20	Microchip Technology, Inc.	**PIC16F1509T-I/SS**
1	U2	MCHP ANALOG SWITCHER Boost 2V to 5.5V MCP1624T-I/CHY SOT-23-6	Microchip Technology, Inc.	**MCP1624T-I/CHY**
1	U3	MCHP MEMORY SERIAL EEPROM 2k I2C 24LC024T-E/MS MSOP-8	Microchip Technology, Inc.	**24LC024T-E/MS**

Note 1: The components listed in this Bill of Materials are representative of the PCB assembly. The released BOM used in manufacturing uses all RoHS-compliant components.

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